ERGONOMICALLY DESIGNED AUTOMATED SHOPPING BASKET

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***Abstract*— In modern India where people talk about smart cities and India as a digitizing nation, it is very important that we start with necessities of citizens. Grocery shopping is one such necessity that requires modernization. There has always been a long queue at the billing counters in shopping malls. This activity many times consumes lot of time which results in frustration amongst customers. This problem is faced by everyone. Especially in India where there is a lot of population and not enough billing counters. There are online grocery stores available, but they have their own disadvantages like minimum bill value etc. To overcome this problem an idea has been developed which can be implemented in all the shopping malls to save customer's precious time and simplify the billing process.**

In a country like India where cost is an important parameter, it is important to keep in mind the manufacturing cost of the product. If the cost is low without compromising the functioning, the model can be implemented on a larger scale. Considering this the model has been built with the most commonly available and efficient hardware. This paper describes the idea of smart shopping basket and how it can be built using basic cost-efficient hardware. In the proposed model, Radio Frequency Identification (RFID) has been used to detect grocery items. Every product will have a RFID tag and every cart will have a reader. A RFID reader is used to decode the tag and display the information on a small Liquid Crystal Display (LCD). Technical working of the circuit with hardware specifications has been discussed and ways of optimization have been suggested. Different variants of this idea have been studied from research papers and a simplified and effective model with working has been proposed in this paper.

Keywords— Automatic Billing, Smart Shopping, Bill, Liquid Crystal Display, Radio Frequency Identification, Customers.

IV. INTRODUCTION

In the past few years Internet of Things is the technology which is growing rapidly and has won attention of almost all the industries in the in world. The main aim of this technology is to bring all the things (smart devices) which we use in our daily life over a network and they can be accessed across the world. Adaption of this technology has brought a paradigm shift to our professional as well as personal lives. It has been predicted that in coming decade trillions of devices are going to be connected over the network and there will be huge amount of data on the servers. As the technology grows, the human interaction or interfacing with the machines is going to reduce and the machines on their own are going to communicate with each other. to study this huge amount of data the person with a knowledge of data analytics and data interpretation is required. In coming years, Data analysis is also going to increase.

Electronics is the vital part of Internet of Things. In future the development of electronic devices is going to increase rapidly. Devices which can hold huge amount of data, different of types of sensors are part of technology called Embedded Systems. It is the technology used for automation in various applications. Generally, an embedded system does a specific task assigned to it, monitors a particular system or environment, collects the data from the smart devices and transfers it to the gateways from where this data is transferred to the servers or cloud for data analysis.

The working principle behind this project is to read the RFID tags of selected product and display its contents on the LED screen. Each product will be having these RFID tags as they carry information such as manufacturing date of the product, price and expiry date. Elite features of this project include understanding consumer trends, budgeting limitation, future forecast of commodities.

V. BASIC TECHNOLOGY USED

II.A RADIO FREQUENCY IDENTIFICATION

Radio Frequency Identification deals with the detection or identification of radio waves and decoding the information from the waves. Radio-frequency identification (RFID) in simplest terms is technology to electronically detect the presence of an object with the help of radio signals. It is used for keeping a track of number of objects in our inventory. RFID is an effective replacement for current bar code technology. The technology is used for automatically identifying a person, a package or an item [2]. The system majorly includes two parts mainly the tag and the reader. It works on the principle of magnetic induction. The reader detects the card whenever the coil inside the tag is activated [2].

II.B ARDUINO

Arduino UNO is a micro-controller board with Atmega328 IC. It has 5 analog Input pins and 14 digital input/output pins. Each pin is capable of supplying 20mA of current and can provide a maximum output voltage of 5v. It is an open source platform and can be programmed easily. The board supports I2C and SPI communication protocol. The board can be powered by USB type B plug from computer. Also, there is a provision of external power Jack 7v-12v supply. The input supply can be accessed on the pin Vin [1]. There are 6 PWM pins available for controlled duty cycle. The board has a clock speed of 16MHz and internal flash memory of 32KB, 2KB of SRAM and 1KB of EEPROM [1].

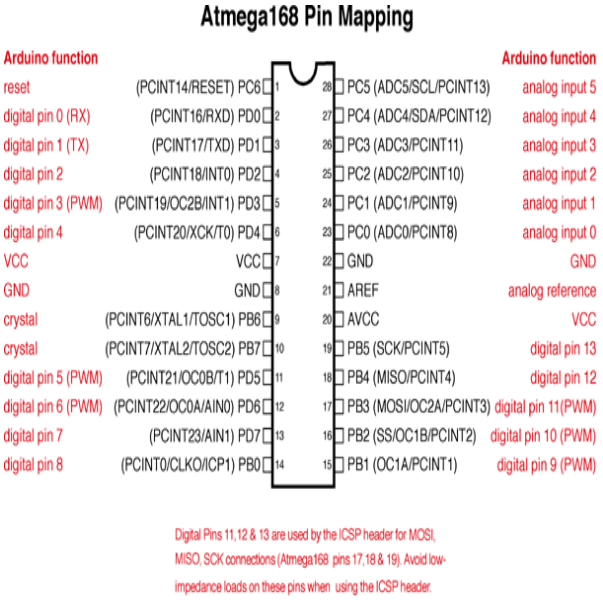
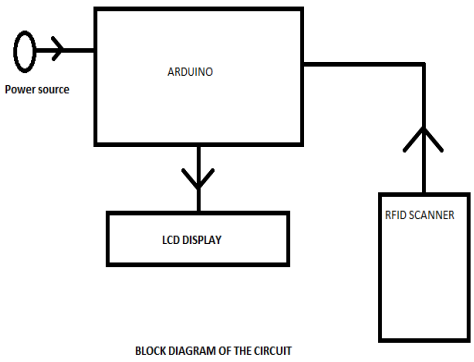


Fig 1. Pin Diagram of Atmega 328

II.C Liquid Crystal Display

A Liquid Crystal Display (LCD) is a type of output device that displays characters on a backlit screen. There are various types of LCD's available; the one used in this prototype is a 16x2 display [3].

III. Block Diagram Of The Circuit



As seen from the diagram RFID scanner is an input device to the Arduino which provides unique ID of the tag to the controller[6]. After the ID is obtained further processing is done by the Arduino and LCD, which is an output device displays the corresponding result on the screen. Arduino is externally powered from Adapter which can be a battery source as well. RFID scanner and LCD display are powered from the power pins on the Arduino board. RFID works on 3.3v supply pin of Arduino.

IV. Working Of The Circuit

The circuit needs to be powered on by a DC adapter(5-20V). When the circuit is switched on the RFID module MFRC522 which works on 3.3v is also powered ON [2]. The circuit starts looking for RFID tags. Whenever a tag is detected its UID is extracted. Every RFID tag has a unique identification number which can be processed to carry out further working of the circuit. In this algorithm when the UID is extracted it is stored in a string and then the string is compared for further instructions. Hence each UID corresponds to a unique product stored in the shop's database. Therefore, whenever the tag is scanned, relevant information is displayed on the LCD and the total bill value is added in a separate variable. If the same card is scanned again the bill value is subtracted from the total bill which indicates that the product has been removed by the customer[4]. There is a separate RFID tag which acts as a master for the system. When the master card is scanned total bill is displayed and the payment is made. The bill value is reset to zero after scanning the card which indicates bill paid. In this way the complete system can be installed in a shopping basket for the convenience of the customer and thereby reducing the effective billing time[7].

Pie chart analysis

Every order or demand of a consumer follows a particular trait. Our task is to visualize a relationship between products and see the share of orders that includes each product or combination of products. The Multi-layer Pie Chart can help us to draw each product and its intersections with others. By this data interpretation we can find relationship between customers' demands and purchasing trends. This will help us to predict products according to the cart items which might be forgotten by the customer. This will not only be a convenience feature but also a business strategy for markets.

Following is the pie cart analysis of day to day life routine items with their statistical analysis.

The below pie cart analysis shows purchasing trends of various customers. This helps to forecast the purchasing trends of customers .

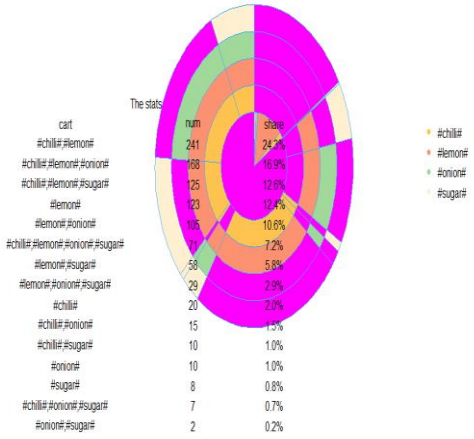


Fig.2.Pie Cart Statistical Analysis

Queuing theory in shopping market

Predicting the waiting times of a particular customer along with the queue length prediction will provide effective management of rush and crowd at the billing counters. Also use of estimated arrival time of customers will be useful for effective staff management at malls and will conserve time and improve facilitation.

Single-Channel Queuing Model with many queues and Poisson Arrivals and Exponential Service Times is analyzed. The most common case of queuing problems in malls is the multiple-channel, or multiple-server, waiting line. Multiple queues are analyzed with respect to random customer arrival.

Following images show waiting time for Poisson distribution queue :

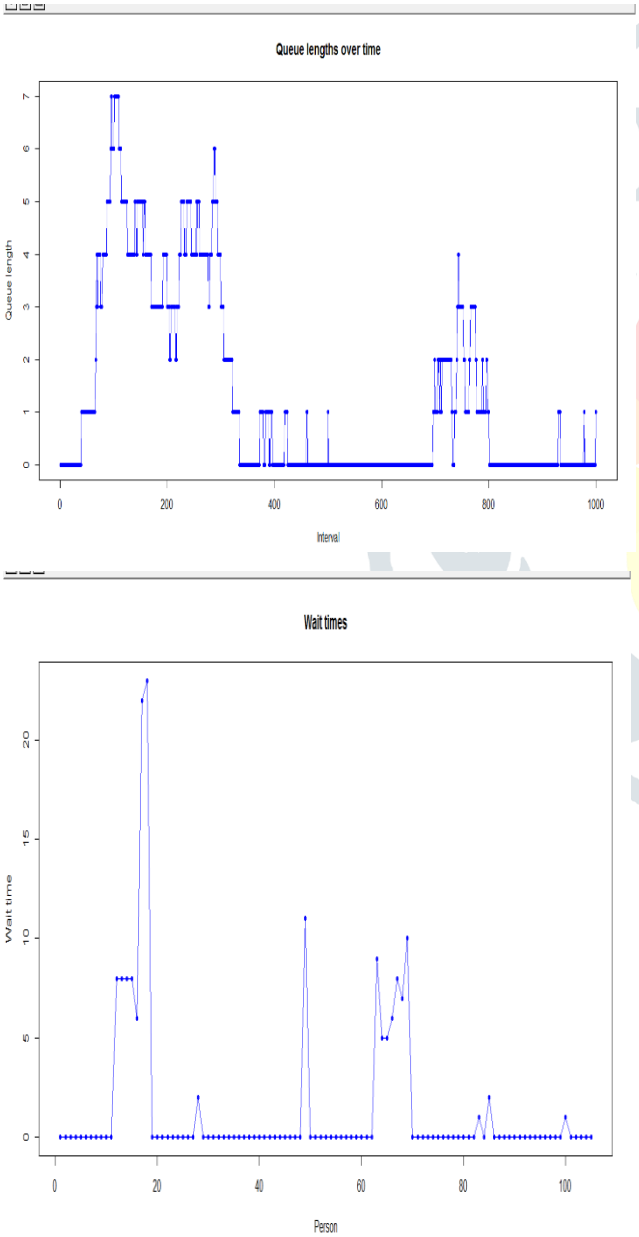
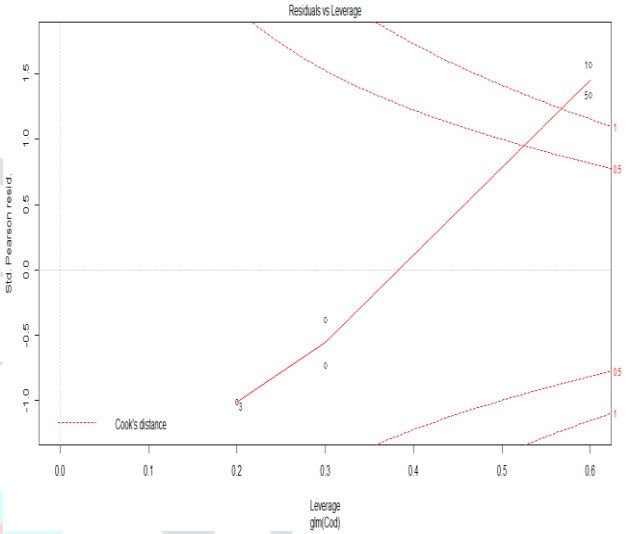


Fig.3.Queuing Trends over waiting times

Low profit yielding product strategy

Every product is subject to change with respect to the market variations and thus a product profitable now might not be profit yielding in the future. Also to keep such products becomes costly and cumbersome. Thus according to the cook's analysis and predictive probability theory, we can differentiate from such bunch of products causing hefty losses.

Following image shows product 1, 5 outside cook's lines and thus can be terminated from sales.



IV. RESULTS

The circuit was built and assembled in a cardboard box for demonstration purpose.
RFID tags works real time and have a very good response time. The working of RFID is compared with Bar code in the table below

RFID vs. Bar Codes

S.No	Feature RFID	Tags	Barcodes
1	Read more than one item at a time	√	×
2	Read while item is moving	√	×
3	Programmable	√	×
4	Line of site read not required	√	×
5	Lifetime guarantee	√	×
6	Able to resist water damage	√	×
7	Built-in security	√	×
8	Inventory tool without handling items	√	×
9	Able to locate specific items on shelves	√	×
10	Use with borrower self checks units	√	√
11	Use with automatic returns units	√	×
12	Use with automated sorting and handling systems	√	×

Fig.4. Table showing comparison of RFID with Bar code

Interfacing of RFID cards with Arduino understood and implemented using MFRC522 module [12]. The circuit is a low-cost model and very easy to use for the customer and hence

efficient. This variant is suitable for Indian market and can be easily implemented in all the stores.

Fig.5.Product Purchasing Trends over time
Above statistical results shows retention of old non selling goods proves to be unfruitful as time elapses.

V. FURTHER RESEARCH AND ADVANCEMENTS

The idea is quite popular in foreign countries and is being implemented in many shops. All of the used modules can be interfaced via Internet of Things to reduce the wiring and build a centralized billing system in the shop where all carts can be monitored from one server and real time bills can be sent to the customers on their phone. This will also save paper printing. Theft in the shop can be monitored by image processing where each product can be live tracked in the shop [4]. If the product crosses the permitted area without being billed a notification will be sent to owner about the theft. Also bulk orders can be avoided with respect to nonprofit yielding products with future forecasting.Hence the idea can be very well developed into an efficient system and implemented on a large scale.

VI. CONCLUSION

A simple idea was implemented and integrated in a working model which is useful for everyone. It will significantly reduce the wait time of customers in shopping queues in super markets and departmental stores.RFID tags works very well and accurate as compared to barcodes which when tampered cannot be processed.

VII. REFERENCES

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